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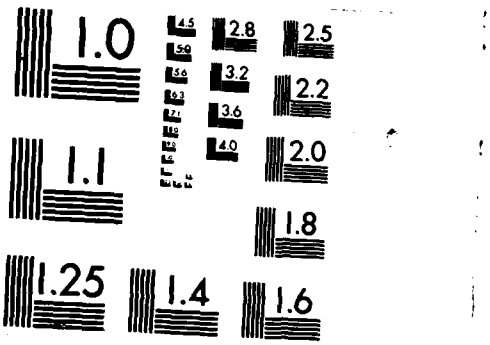
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THE DoD GATEWAY INFORMATION SYSTEM (DGIS): USER INTERFACE DESIGN

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REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION Unclassified/Unlimited	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution unlimited.
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) DTIC/TR-87/1	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION Defense Technical Information Center 6b. OFFICE SYMBOL (If applicable) DTIC	7a. NAME OF MONITORING ORGANIZATION
6c. ADDRESS (City, State, and ZIP Code) Cameron Station Alexandria, VA 22304-6145	7b. ADDRESS (City, State, and ZIP Code)
8a. NAME OF FUNDING/SPONSORING ORGANIZATION 8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State, and ZIP Code)	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. 65801S; PROJECT NO.; TASK NO.; WORK UNIT ACCESSION NO.

11. TITLE (Include Security Classification)
The DoD Gateway Information System (DGIS): User Interface Design. (U)

12. PERSONAL AUTHOR(S)
Allan D. Kuhn & Gladys A. Cotter

13a. TYPE OF REPORT	13b. TIME COVERED FROM ____ TO ____	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
		8609	8

16. SUPPLEMENTARY NOTATION
Presented at and published in ASIS '86, Proceedings of the 49th ASIS Annual Meeting, Chicago, IL, 28 Sep-2 Oct 86

17. COSATI CODES		
FIELD	GROUP	SUB-GROUP
5	2	
9	2	

18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
Gateway, Front-end, Interfaces, Networking, Libraries, End-users, Menus, Menu system, DoD Gateway Information System, DGIS, Intelligent gateway

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

The Department of Defense (DoD) Research and Engineering (R&E) community requires rapid access to scientific and technical information relevant to their mission areas. The information they need is in a multiplicity of diverse databases maintained in the federal and commercial sectors. A tool being developed to satisfy these information requirements is the DoD Information Gateway System (DGIS). The Defense Technical Information Center (DTIC) is the program manager for the DGIS. A prototype version is now undergoing test and evaluation. The objective of the DGIS is to provide the DoD researcher with a single, easy-to-use interface for accessing, interrogating and post-processing information from the numerous databases relevant to their needs. To the user's mind, the DGIS transforms these resources into a single entity - a virtual database. DGIS includes a menu system as an option for handling information. The menu system guides the user through the paths of accessing and processing information via the DGIS. Development of this menu system is discussed in this paper.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT ☐ UNCLASSIFIED/UNLIMITED ☒ SAME AS RPT. ☐ DTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION Unclassified/Unlimited
22a. NAME OF RESPONSIBLE INDIVIDUAL Allan D. Kuhn	22b. TELEPHONE (Include Area Code) (202) 274-5367 22c. OFFICE SYMBOL DTIC-ER

DD FORM 1473, 84 MAR 83 APR edition may be used until exhausted. All other editions are obsolete.

THE DoD GATEWAY INFORMATION SYSTEM (DGIS): USER INTERFACE DESIGN

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ABSTRACT:

The Department of Defense (DoD) Research and Engineering community requires rapid access to scientific and technical information relevant to their mission areas. The information they need is in a multiplicity of diverse databases maintained in the federal and commercial sectors. A tool being developed to satisfy these information requirements is the DoD Gateway Information System (DGIS). The Defense Technical Information Center (DTIC) is the program manager for the DGIS. A prototype version is now undergoing test and evaluation. The objective of the DGIS is to provide the DoD researcher with a single, easy-to-use interface for accessing, interrogating and post-processing information from the numerous databases relevant to their needs. To the user's mind, the DGIS transforms these resources into a single entity - a virtual database. DGIS includes a menu system as an option for handling information. The menu system guides the user through the paths of accessing and processing information via the DGIS. Development of this menu system is discussed in this paper.

I. INTRODUCTION

The Department of Defense (DoD) research and engineering community requires rapid, easy access to scientific and technical information relevant to their mission areas. The information they need is contained in a multiplicity of diverse databases maintained in the federal and commercial information sectors. A tool which is being developed to satisfy the information requirements of this community is the DoD Gateway Information System (DGIS).

The objective of the DGIS is to provide DoD researchers with a single, easy-to-use interface for accessing, interrogating and post-processing information from the numerous databases relevant to their needs. To the researcher's mind, the DGIS transforms those heterogeneous resources into a knowledge entity - a single, virtual database of his domain of expertise. The Defense Technical Information Center (DTIC) is the program manager for the design, development and implementation of the DGIS. A prototype version of the DGIS is now undergoing test and evaluation. Eight information services have been selected as targets of the prototype gateway (1). Access, command, downloading and post-processing routines are being developed to provide the user with the single, easy-to-use capability to handle the vast amount of information in the virtual database entity that constitutes the user's knowledge domain.

Currently, three user interface modes for accessing and handling this information are being developed and applied in the DGIS to get the user to his domain. These modes are menu, command, and an off-the-shelf user assistance access and search interface. The use of these modes is optional, depending on the user's skill level in both using DGIS and accessing diverse databases. These modes are available now in their various developmental levels of functionality, but all highly usable. A fourth area, still in basic development, is a system common command language capability, to give relief to the problem of having to address databases in each of their native command languages.

As mentioned, the modes are made available to the researcher to use at his discretion for accessing and handling information. The assistance interface services the casual, novice user for accessing and aggregating information from diverse databases. The DGIS menus lead the more knowledgeable novice user through the paths of getting the information and processing it, and the DGIS commands that the novice learns in the process will raise the skill level to command mode for more rapid information handling. Since the menus are pivotal to using DGIS, this paper speaks to the development of the DGIS menu interface.

II. BACKGROUND

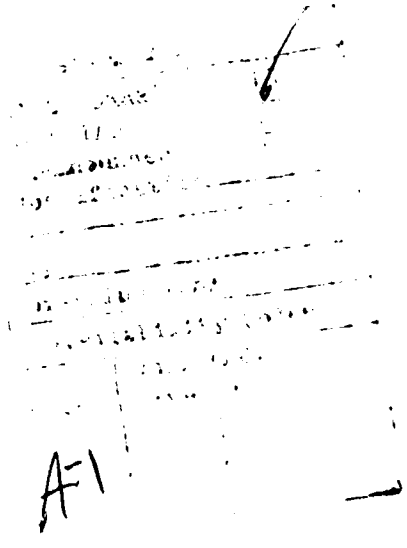
The Defense Technical Information Center (DTIC) is charged with providing information services to the

9. Meheroo Jussawalla, "Can We Apply New Trade Rules to Information Trade?" in International Information Economy Handbook, G. Russell Pike and Chris Brown, eds. (Springfield, VA: Transnational Data Reporting Services, 1985), 11.

10. Ibid.

11. S. Golt, "Towards Freer Trade in Services" The Banker, (May 1982).

12. Kent Calder, "Multinational Firms and Global Information Industry Development," for TIDE 2000 Symposium -- Telecommunications, Information and Interdependent Economies, Nov. 12-14, 1985, Tokyo, 4, 7.



Department of Defense scientific and technical community. These services range from collecting and disseminating bibliographic information to sponsoring and directing research into innovative information handling technologies. DGIS, in development to provide online, streamlined methods for identifying, accessing, searching, post-processing, and analyzing information from diverse databases, is one of DTIC's most important developments to promote access to scientific and technical information database resources (2).

DGIS has been developed on the Technology Information System (TIS), a Department of Energy system resident at Lawrence Livermore National Laboratory (LLNL), Livermore, CA. TIS is a prototype information gateway which is the pattern system on which gateway nodes are in various stages of development for Energy, Defense, and NASA, with nodes also planned in other agencies. TIS, as an intelligent gateway processor, is well along in its development. It supports access to external resources, the downloading and uploading of data, simultaneous searching, and post-processing (3). This particular orientation is an application of the Berkeley UNIX software development, with which TIS is further developing software for intelligent gateway computers suitable for the prototyping of advanced, integrated information networks. TIS developers use it to lead the user to information resources by means of a directory and automated access procedures, with the overall goal of transferring information and technology acquired from and among the wide range of geographically dispersed information resources (4).

Major requirements for the use of DGIS have been determined through DTIC user community surveys and site visits. These requirements showed six critical areas for incorporation into a DoD gateway system (5). These areas were:

- A gateway user interface
- A directory of databases
- Remote database connection routines
- Common data retrieval routines
- Simultaneous search capabilities
- Data analysis and post-processing routines

The DGIS was to be built on the concept of giving the user a means to process information with a computer system, as compared with a computer system processing information in a pre-determined way and then handing that information to the user. The requirements in establishing the basis for the utilization of the system also implied the conceptual structure for the system's menus, to function through the foundational TIS software capabilities.

III. DEVELOPMENT OF THE MENUS

1. Menu Use Concepts

The initial task in designing the menu system was to define the full range of DGIS capabilities and to identify those which would benefit our users. An array of commands existed which were a compilation of UNIX operating system commands and TIS commands. Additionally, there was a number of modular menus which had been designed for a UNIX-facile user community -- definitely not the DGIS community. The first order of the DGIS menu structure was to unify the commands and the menu sets. This unification was to serve as a basis for leading the DGIS user through the functions and capabilities of the system.

A primary concept was the inclusion of a user-usable command language. No lengthy discussion was needed to conclude that a usable language is English. Command length was not considered a hindrance since commands would rarely be more than one word. The structure of the menus, therefore, included incorporating the actual commands as indicators of the capabilities and functions.

Realizing, however, that to go through the menu structure on English language commands alone would require constant and repetitive key-stroking, number indicators were incorporated. A number not only serves as a surrogate command but also indicates the menu area and level.

Menu area access was considered to be an important issue. Going up and down through the menus to get from one capability module into another was judged to be tedious. The concept of accessing any menu module at any level from any area in the menu structure was incorporated. Furthermore, this concept included returning to menu area point of change, in the user's processing of his information. This concept application is useful, for example, in working with a file, and on judging it to be ready for presentation, going from the files module to the electronic mail module to transfer that file to another user. The user then reverts to the menu area in which he was originally working. The very basic idea of the

menu access concept, therefore, is that access is up/down, sideways, diagonal, jump-around, and reversion.

Furthermore, we realized in looking at other menu systems the strong advantage of incorporating a method of menu-use continuity, or at the very least, a way to escape when a process becomes confusing. We have therefore included a set of command option constants to accomplish continuity, displayed at the botton of each menu display. These options allow the user at any time to enter any menu number, any command, backup to higher level menu, go back to the DGIS top menu, or simply end the session.

2. Conceptualizing the DGIS Menu Interface

A review of the task effort pointed out that a DGIS menu interface had to be based on a clear understanding of the DGIS mission requirements. Therefore, the basic functions of DGIS in fulfilling its mission were delineated, with the help of the requirements study, as follows:

a. Inclusion of a database directory. With over 3000 databases online containing scientific and technical information, users generally have a comprehensive selection from which to extract knowledge in their domains. But with an ever-expanding number of databases, it is an awesome task to both keep track of pertinent databases and maintain awareness of new ones. The DGIS directory is to maintain awareness of the database universe and to be subject searchable so that the researcher may get a list of pertinent databases.

b. Remote database connection routines. Communications are the backbone of any gateway system. DGIS users are to access not only information databases but also people. DGIS communication capabilities, then, break out into connection routines for automatically logging into databases and telecommunication networks, electronic mail, online realtime interactive communicating between users, and simple dial access to systems not included in the automatic connect routines.

c. Common data retrieval routines. This area is still in initial research and development for DGIS, and based on a review of the literature, also apparently in general. This concerns the establishment of common retrieval facilities such as a common command language, cross-command translated language use, and a wide range of software apppli-cations for front-ending databases. In relation to the DGIS menus, however, common data retrieval routines will be incorporated as options. The user will invoke them through the menu or by command. DGIS has made an initial step in this direction by making available an experimental front-end interface for accessing and searching databases. This has been incorporated as SearchMAESTRO (6) in the menu.

d. Simultaneous search capabilities. Realizing that comprehensive information relevant to the researcher's need is scattered throughout diverse databases, a query may be run against those databases simultaneously. Search results are viewable on the terminal screen foreground, or may be relegated to background processing, thereby freeing the screen for other tasks.

e. Data analysis and post-processing routines. After having aggregated information from diverse databases, there is often a need to analyze or post-process that information for it to be useful to the researcher. Because of the sheer volume of information that is possible to collect, the DGIS includes automated methods for analyzing and processing large amounts of data. The ability to reformat, merge, sort and analyze data downloaded from remote databases to the benefit of the researcher catalyzes the transformation of an information glut into information gold (7).

3. STRUCTURING THE DGIS MENUS

Structuring the menus according to the system needs and capabilities was an exercise in:

a. Delineating the parameters of the system requirements,

b. Conceptually merging those needs and the system capabilities,

c. Partitioning the needs-capabilities into modules,

d. Interfacing the modules and their sub-functions correctly, and

e. The dirt-deep nitty-gritty writing of the menus.

The DGIS base menu as a consequence served not only as the top, or first menu, but also as an announcement of the system's major capabilities and features. Initially, this menu incorporated:

a. The requirements of a directory of databases.

b. Communications capabilities, including remote database connect routines and connecting with people, and the already mentioned SearchMAESTRO search interface.

c. Routines for downloading information, including simultaneously.

d. Routines for processing information as a means for making compilations of information more useful to the user.

Additionally, included in the base menu were supporting features furnished by the software:

a. A separate electronic mail feature.

b. A files manipulation operations set.

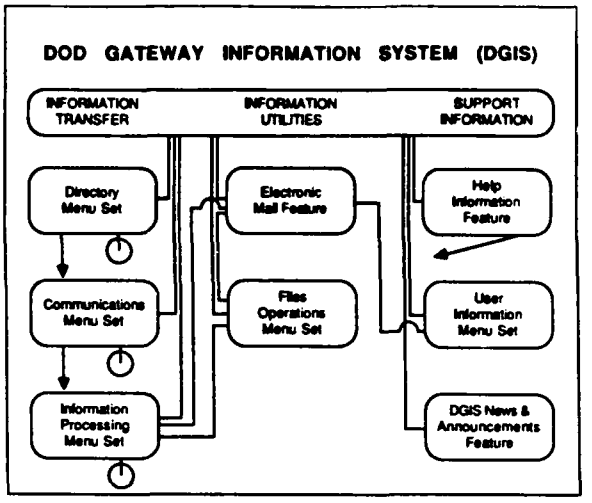
c. A searchable DGIS users directory feature.

d. A DGIS "What's New" (news) feature.

As these major features gathered together, a higher-level taxonomy became evident, not handed down in stone, but to be indicated on the main menu as a means of separating and giving order, in the user's view, to the basic features relative to the DGIS mission. The taxonomy was:

Information Transfer Modules- This category brings together the remote information access and processing features.
Information Utilities- This category brings together the features that allow the user to manipulate and transfer the information.
Support Information- This category convocates the internal DGIS information considered useful to the user and therefore made accessible.

Concurrently, the module interfaces for the menus also became clear. The order and relations were charted diagrammatically to ascertain the menu interfaces, as follows:



Concept changed into substance through this diagram and the DGIS menu interface acquired reality.

IV. THE DGIS MENUS

1. The Top Menu

The DGIS top menu, in starting the user off on his information processing journey through the system, not only displays the major capabilities of the system, but in doing so also serves as a marketing device for the system. The top menu comes up immediately on logging-in to welcome the user to the system, and he sees:

```
0          WELCOME TO THE DoD GATEWAY INFORMATION SYSTEM

      >>>>>>>>>>>INFORMATION TRANSFER MODULES
      1          directory          DGIS Directory of Online Resources
      2          communicate        Connect to information resources and people
      3          process            Information product tailoring

      >>>>>>>>>>>INFORMATION UTILITIES
      4          em                 Electronic Mail
      5          files              File operations

      >>>>>>>>>>>SUPPORT INFORMATION
      6          help               Description of features
      7          users              DGIS registered users
      8          info               DGIS news and information
      9          dtiolog            DGIS full text retrieval

      DGIS HOTLINE NUMBER (703) 276-8182
      or send questions via DGIS EM to 'dgishelp'

Enter a menu number, a command, "b" to backup, "t" for top, or "e" to end
*
```

2. Sub-Level Menus

The top menu branches into the second level DGIS functional menu sets. Each menu at that level includes a concise explanation of the function module, with descending function-specific subsidiary menus as needed that lead the user through the processes.

Since the displays themselves give the best view of a menu-driven system, let's use our Communications module as

an example. The following shows each menu and a response. Note that each menu includes the continuity options at the bottom and a numeric menu area and level indicator at the top. Additionally, each response or process conclusion includes the continuity instruction of entering a carriage return to continue.

Thus, at the prompt in the top menu one enters "2" (or "communications") and brings up this second level menu to select and begin the desired communications process:

```
*2

2                COMMUNICATIONS

     DGIS will automatically connect you to a wide range of remote
     information systems and to other people online the DGIS. For
     information systems, you must have already registered with
     these systems and have provided DGIS your access passwords.
     Select as follows:

     >>>>>>>>>>SEARCH INTERFACES
     2.1        maestro          SearchMAESTRO - menu driven search aid.

     >>>>>>>>>>NATIVE MODE
     2.2        multi            access multi-type information systems.
     2.3        factual          access factual and numeric databases.
     2.4        media            access news services.

     >>>>>>>>>>OTHER COMMUNICATIONS
     2.5        dial             unassisted dial into other systems.
     2.6        people           communicate interactively with DGIS users.

Enter a menu number, a command, "b" to backup, "t" for top, or "e" to end.
*
```

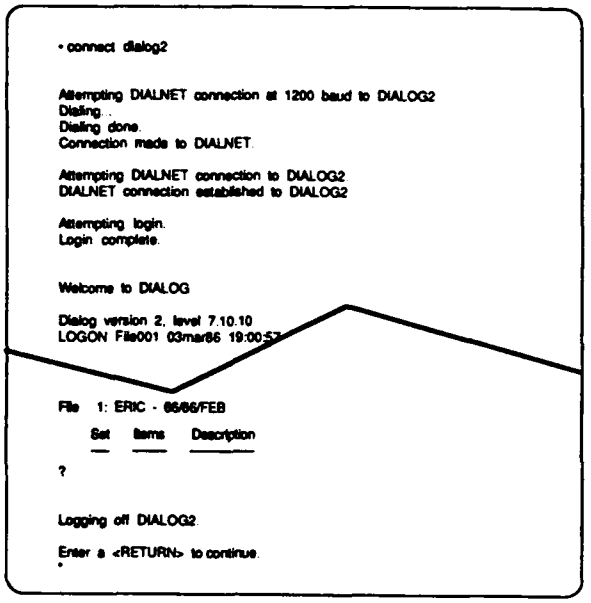
The display of DGIS communications and access functions illustrates how the *second level menu provides a choice* of specific functions. The menu also categorizes the communications functions to indicate the multiple options that DGIS is offering for accessing information resources. The first option in this case is the SearchMAESTRO user search assistance interface already mentioned. So, if one enters the menu number (or command) for maestro, one gets:

```
*2.1
2.1      maestro

Attempting dialup to Maestro at 1200 Baud
Please Standby
Dialing
Dialing done.

Attempting login sequence
Please Standby
Library code accepted
Terminal type validated
Enter search mode of Maestro
Password accepted
Almost there. Be patient
Finally done. Its about time
Login into Maestro is now complete
To logout, press <ESC> <CNTL> D

PRESS          TO SELECT

    1      DOD Gateway - I    We pick the database

    2      DOD Gateway - II   You pick the database

    H      Help

-> h

Gateway - I:  For the inexperienced
searcher.  After you select a category
from the menus, enter your questions.
Gateway - I automatically selects the
appropriate database and translates the
question into the command language of
the vendor.  The cost of the search is
fixed.

Gateway - II:  Has a greater selection of
databases.  You select the database and
enter your question.  Your question is
then translated into the command lan-
guage of the vendor.  The cost of each
search is fixed.

Press (return) to continue...->


Logging off maestro.

Enter a <RETURN> to continue.
*
```

Relative to this option, the automatic connect process may seem a little tongue-in-cheek. But its purpose is to let the user know what is going on during the extended connect and access period. The response display initiates the user to the maestro function. One follows the interface's menus until ready to leave through the <ESC> <CNTL><d> command. This activates the automatic logout and brings up the DGIS instruction to <RETURN> to continue. The return brings back the Communications menu.

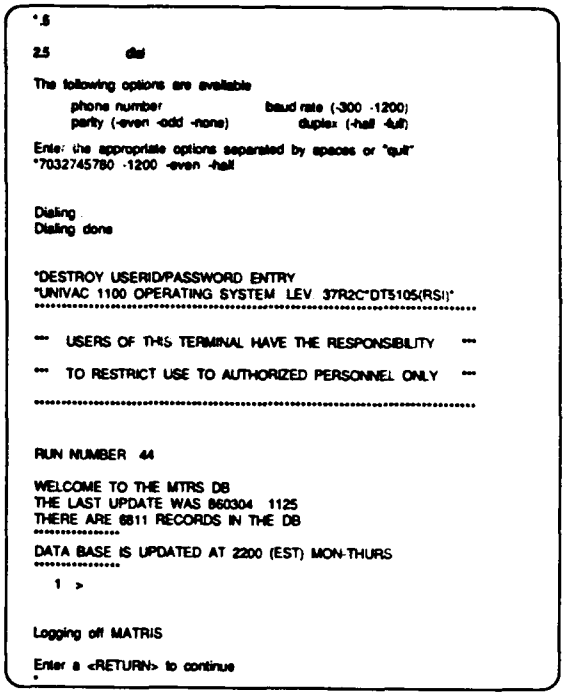
If the researcher should want to search a remote database in native mode, he may again enter a menu number or the command shown to descend to a sub-level menu which brings him to function-specific options. In the

case below, he has entered "multi," as shown on the Communications menu. This brings up the sub-level menu showing the multi-type category of information systems. This particular sub-level menu shows the menu numbers (and command entries) for systems with which DGIS has automatic connect routines. This menu is also represent ative of the other native mode data-base categories shown on the Communi-cations menu. In the illustration below the user has again chosen to enter the command line, rather than the menu number (which may mean that he is on the verge of using commands directly rather than through the menus for quicker information processing..):



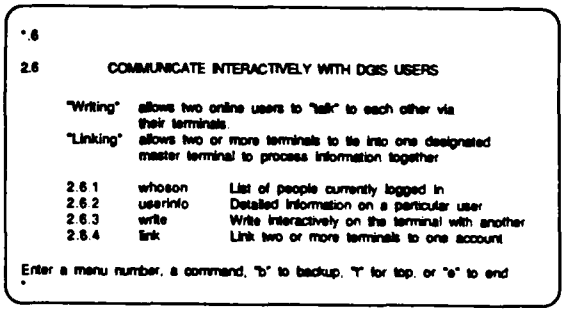
Again, relative to this particular entry, the response display shows the process of the connect routine, then the researcher's entry into the DIALOG database down to the logout routine and the DGIS appearance of the "RETURN to continue" instruction, to lead back to the Communications menu.

In the communications area, DGIS provides the capability for users to dial into any system they can access with their access codes. Obviously, "dial" is good for systems for which DGIS does not have automatic connect routines. Also, in the illustration below although the user might have accessed the MATRIS database with the connect routine, he also may not yet have been granted DGIS access. But he has elected to access MATRIS through DGIS in order to keep his information from diverse databases together in his DGIS account. He therefore has entered the menu number for "dial," and responding to the "dial" sub-level menu he will enter the appropriate information to have DGIS access MATRIS, as shown by the display:



3. Subsidiary Level Menus

Lower level menus are incorporated as needed. For example, in DGIS people also are considered as informa-tion resources. DGIS therefore includes in its Communications options contacting people directly. The following subsidiary-level menu and the menu responses explain in them-selves the DGIS function in inter-acting with people online, and serve as an example of a subsidiary menu function.



```
*whoson

Name            Port #          Logged on at
-----------------------------------------------
britten         ttykf           Mar 3, 15:11
howland         ttyp0           Mar 3, 15:25
kuwin           ttyp2           Mar 3, 08:34
kelly           ttyje           Mar 3, 15:43
kratzke         ttyh8           Mar 3, 15:23
kuhn            ttyh0           Mar 3, 15:50
operator        ttyhb           Mar 3, 05:07
phoward         ttyh4           Mar 3, 08:53
powell          ttyh1           Mar 3, 14:53
robillar        ttyh3           Mar 3, 12:30
tjt             ttyp5           Mar 3, 10:29

Enter a <RETURN> to continue
*
```

```
* 2

2.6.2           Userinfo

Type the users name(s) or "all" or "quit"
*Cotter

Gladys Cotter  DTIC-EA                          cotter      (703) 274-5367
Defense Technical Information Center
Information Research & Technology
Cameron Station
Alexandria, VA 22314-6145


Enter a <RETURN> to continue
*
```

```
*write cotter


Terminate each message line with a <CNTL> <U>
To end communication, type a <CNTL> <D>

cotter has been notified  Please wait for response
Communications established  Go ahead

Hi, there  The project review mtg time is ok  See you there?
Yes  Make sure everyone knows  Bye
^^^^^  Connection broken by cotter  ^^^^^

Enter a <RETURN> to continue
*
```

```
*link

Type the user name or the terminal identifier you wish to link to
 or "quit"
*powell

Type "s" for student, "t" teacher or "quit"
*s

Do you want to keep a transcript of this link?
Type "yes" "no" "quit"
*yes

Type in the file name to contain this link session
*powell


    ttyh0 now linked to ttyh1   Type control-D to disconnect
ls
113             POSTPROC/       emgroup/        lambadp         powell
DB CREATE       PROJECTS/       graphics/       lamd            pptestbed/
DGIS/           TIS/            lamad           lamdd           sentmail
DTIC/           UNIX/           lamadd          lammero         shell/
DTIC-EB/        a.out*          lamaddd         lamr            testfile
DTICPLANS/      bin/            lamadl          lamt            unsent
HAR/            canned/         lambase         mail/
INDEX           core            lambase1        mailsent
MBO/            development/    lambaseyr       mbox
OA/             dticlib/        lambo2          oldmail
          Link broken

All Done!

Enter a <RETURN> to continue
*
```

V. SUMMARY

Above is the menu progression of one capability in DGIS. This progression, however, shows how the menu sets have been designed and interfaced to lead the researcher through the otherwise torturous paths for getting to and handling information acquired from external sources. The purpose of the system is not only to allow the user the capability to process information on his own terms, but in doing so to also process knowledge which has accumulated throughout the wide range of resources in his domain of expertise. This means not only communicating with database resources but also with "peoplebase" resources scattered over the United States and the world.

After getting their information, researchers may then use the wide range of processing routines in DGIS to tailor their own information aggregations into forms useful to them. The goal of DGIS, therefore, is to get people to the widely-diverse and widely distributed information in their knowledge domains, and to get that information to the people.

VI. ACKNOWLEDGEMENTS

Ms. Roberta Cohen, Ms. Marjorie Powell and Mr. Curtis Generous, of DTIC, formed the team that developed and implemented the DGIS menu interface design.

VII. NOTES

(1) The eight target databases are:
- DoD RDT&E On-Line System (DROLS), DTIC
- Manpower and Training Information System (MATRIS), DTIC
- Department of Energy Information System (DOE/RECON))
- NASA Information System (NASA/RECON)
- Robotics and Artificial Intelligence Database (RAID), NSWC
- DIALOG
- ORBIT
- BRS

(2) Cotter, G. A. The DoD Gateway Information System. Defense Technical Information Center, Alexandria, VA, October 1985, AD-A161 701, p.1.

(3) Cotter, G. A. et al. The Integrated Information System: Resource Sharing Tailored for Local Needs. Defense Technical Information Center, Alexandria, VA, November 1985, AD-A161 700, p. 6.

(4) Hampel, Viktor, et al. "TIS"-An Intelligent Gateway Computer for Information and Modeling Networks: Overview. Lawrence Livermore National Laboratory, Livermore, CA, August 1983, UCRL-53439, p. 1.

(5) ibid. (2), p. 2.

(6) SearchMAESTRO: Menu-Aided Easy Searching Through Relevant Options.

(7) ibid. (2), p. 4.

END

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